



Defense Research and Engineering Network (DREN) IPv6 Deployment Joint Engineering Team

Mr. John M. Baird
September 21, 2010



DREN IPv6 peering relationships



- **JET members**
 - ESNET
 - Internet2 Network/Abilene
 - NLR
 - NREN
- **Other research networks**
 - AARnet
 - Canarie
 - Los Nettos
 - TWAREN
 - ? International Research Network Connections (IRNC)
 - ? America Connects to Europe (ACE)
- **Other networks of possible interest**
 - CalREN/CENIC
 - Google
 - Microsoft



IPv4 address pool exhaustion

“Internet will soon be running on IPv4 address fumes ” – Arstechnica



inetcore.com
IPv4 counter
(predecessor to
HE ByeBye v4)

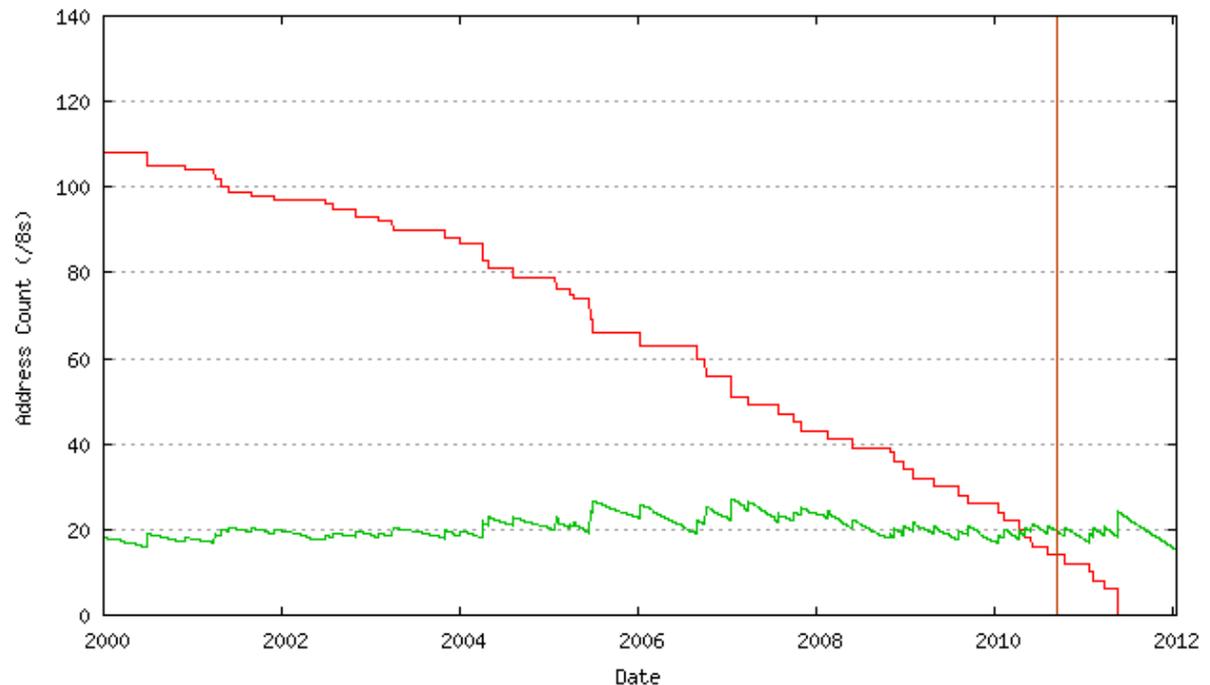


Fig. 35

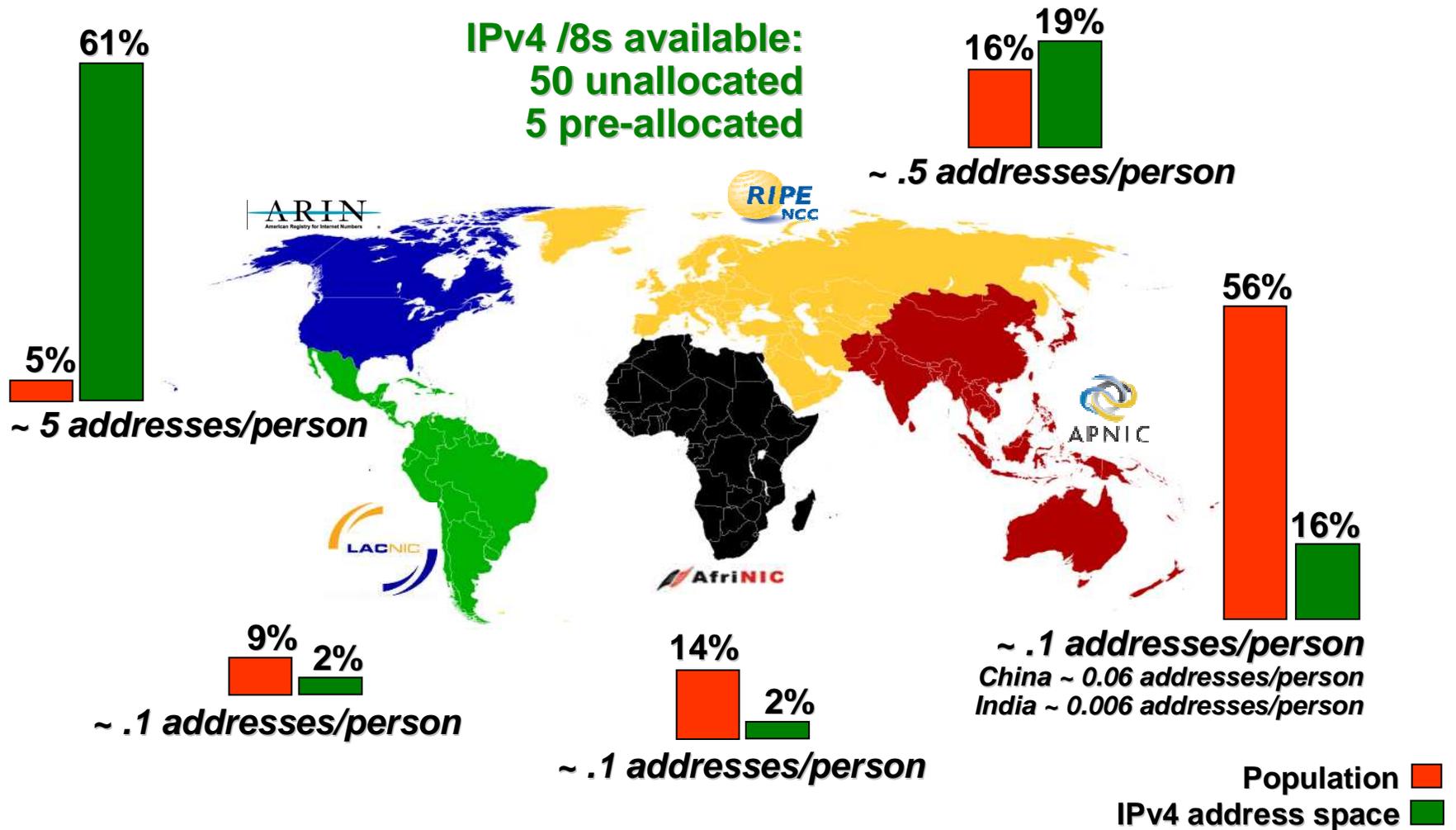
IANA Pool — RIR Pool — Projection — Geoff Huston potaroo.net

“Faced with the choice between changing one's mind and proving that there is no need to do so, almost everyone gets busy on the proof.” – John Kenneth Galbraith





IPv4 address pool exhaustion

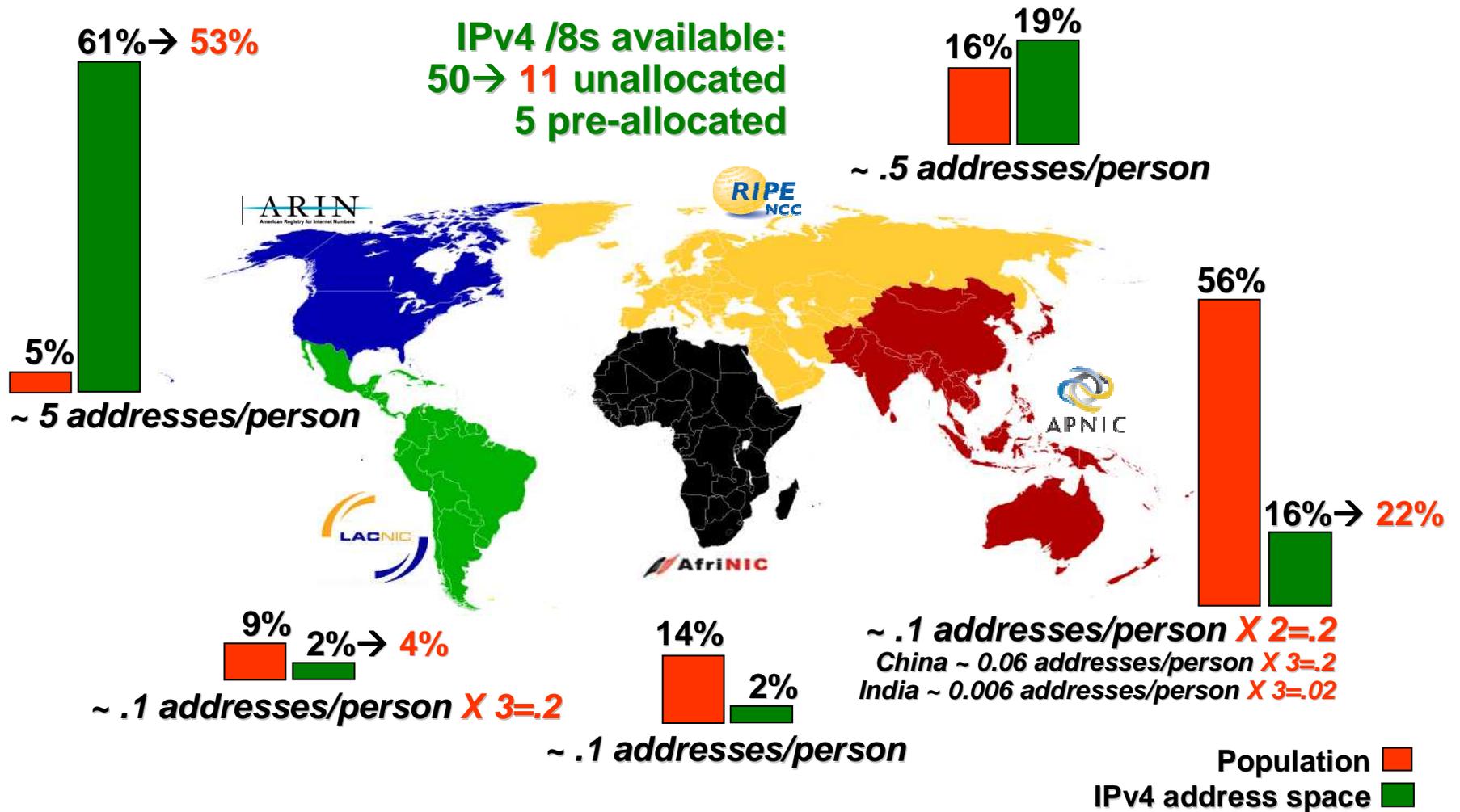


Aug 2007: IPv4 allocations were made unevenly





IPv4 address pool exhaustion

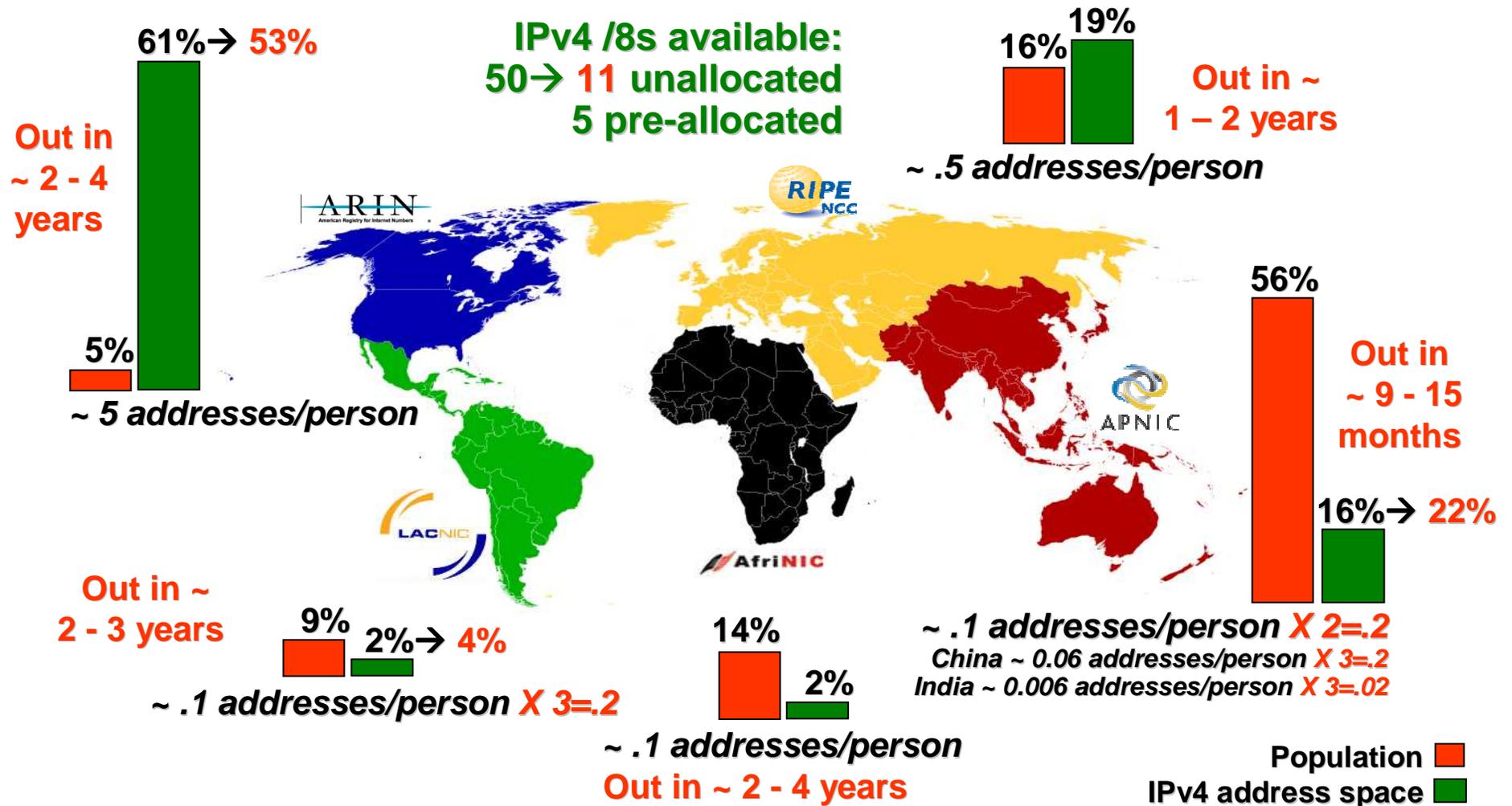


June 2010: IPv4 allocations are still uneven





IPv4 address pool exhaustion



Projection: IPv4 exhaustion will occur unevenly
(see www.ipv4depletion.com for details)



IPv6 global deployment



IPv6



IPv6 Deployment Survey

Based on responses from the global
RIR community during June 2010

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Maarten Botterman

<http://www.nro.net/documents/GlobalIPv6SurveySummaryv2.pdf>



IPv6 global deployment

Q1 - Response to questionnaire

- 1589 respondents from 140 countries/economies
 - 15 countries > 30 respondents = 919
 - 25 countries $7 < x < 30$ respondents = 395
 - 28 countries $3 < x < 8$ respondents = 158
 - 31 countries with 2 or 3 respondents = 75
 - 42 countries with 1 respondent = 42
- Top 10 respondent countries

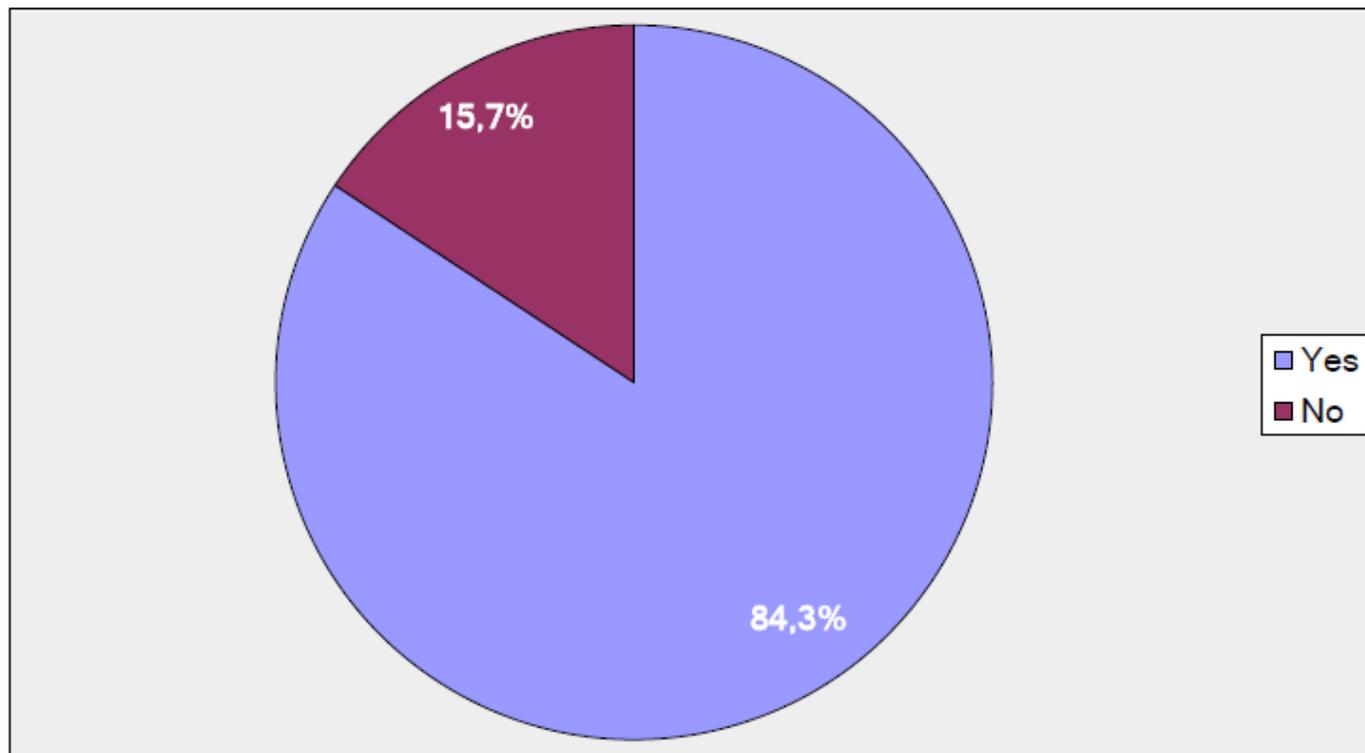
1. USA	214	6. Russia	68
2. Australia	89	7. Brazil	47
3. Germany	81	8. France	45
4. UK	74	9. New Zealand	45
5. Netherlands	71	10. Czech Rep.	42



IPv6 global deployment



Q10 - Does your organization have, or consider having an IPv6 allocation and/or assignment?

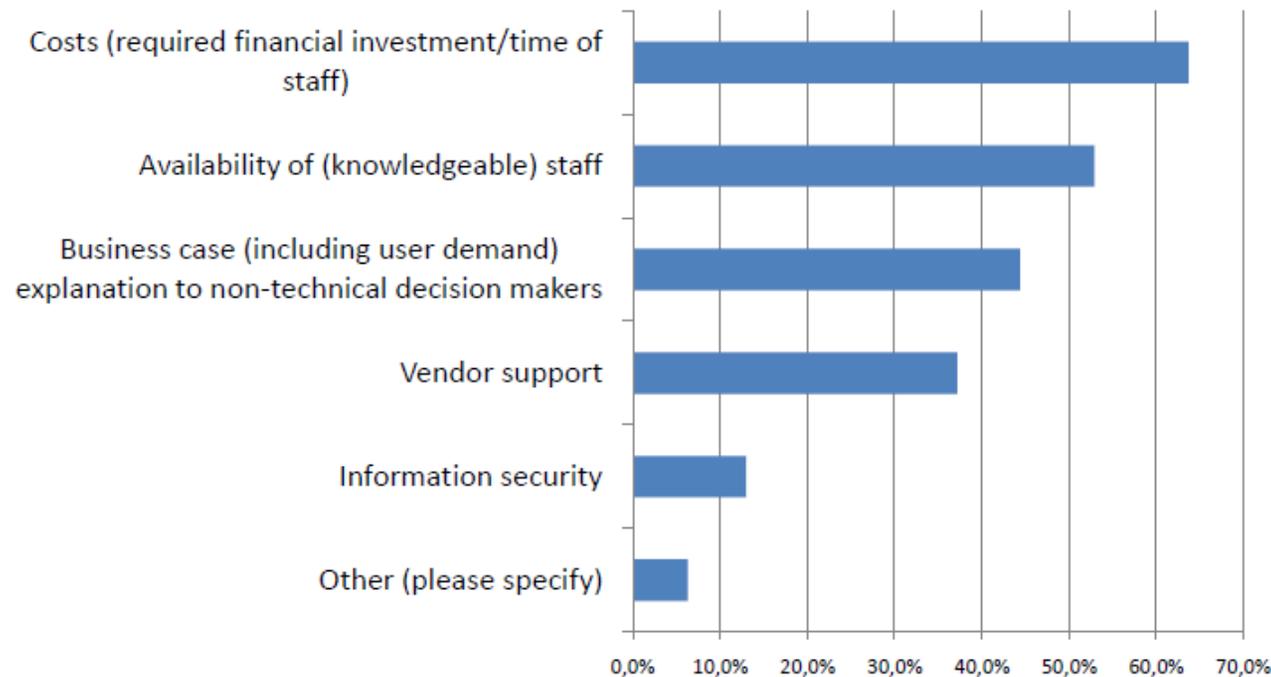




IPv6 global deployment



Q12 - what you expect to be the biggest hurdle(s) to your organization if you were to deploy IPv6?



Please note these are responses from the 14% indicated to not consider having an IPv6 allocation/assignment



Backup Slides





DREN cost to deploy IPv6 on WAN



- **Purchases**

- No hardware was purchased
- Numerous router software upgrades were made, all at no additional cost

- **Personnel**

- No additional personnel were hired

- **Training**

- 1/2 day on-site IPv6 orientation/planning seminar for Network Operations Center (NOC) personnel
- Self-training using suggested reading list and web links

- **Time over 4 month period**

- NOC
 - Workstation with Linux to support IPv6 - 20 hours
 - IPv6 address plan - 50 hours
 - Implementation at initial 12 IPv6 sites - 100 hours
 - IPv6 design testing and troubleshooting - 150 hours
- Backbone design, testing and implementation - 100 hours



DREN site costs to deploy IPv6



- **Purchases by 12 sites to deploy IPv6 in 2003**
 - **Hardware: remarkably few purchases**
 - **Only 2 of the sites had to buy any routers. They were scheduled to be replaced anyway (1 @ \$25,000, 1 @ \$8,200)**
 - **Some sites with Cisco routers chose to replace their Supervisor Blade with newer ones that did IPv6 in hardware rather than software (avg =\$25,000). (Probably not an issue in 2010.)**
 - **It was fairly typical to expand the memory on routers, at a cost of \$500 to \$2,000 per router**
 - **No site had to replace any computers to deploy IPv6**
 - **System Software**
 - **Upgrades from Windows 2000 to Windows XP operating system and from Windows 2000 server to 2003 server were common. No Linux upgrades required. Remember, this was 2003.**
 - **All other software upgrades were covered under existing maintenance contracts at no additional cost**



DREN site costs to deploy IPv6



- **Training by 12 sites to deploy IPv6 in 2003**
 - **Commercial training**
 - 2 sites purchased 3 – 5 day training from NativeV6 @ \$2250/person
 - 1 site sent people to Internet2 2 day workshop @ \$600/person
 - **DREN provided training**
 - Many personnel at each site attended a ½ day on-site IPv6 orientation/IPv6 deployment planning seminar
 - At last six annual DREN Networkers conferences, ½ day IPv6 seminar
 - **Self-training (books and Internet accessible information)**
 - Most personnel at all sites either bought at least one IPv6 book (avg = \$30), or viewed at least one recommended webinar or video (avg = 3 hours), or both



DREN site costs to deploy IPv6



- **Staff effort over a period of 6 to 9 months**
 - **Context: Each site is primarily a computer center, with 1 – 6 supercomputers, massive file servers, a couple of high speed LANs, and a small number (15 – 80) of desktop/laptop computers and visualization workstations**
 - **At the smaller sites, 100 to 200 hours (aggregate) were spent by a team of 2 – 4 part time people**
 - **At the medium sites, 200 to 400 hours (aggregate) were spent by a team of 4 – 7 part time people**
 - **At the larger sites, 400 to 600 hours (aggregate) were spent by a team of 5 – 7 part time people**
 - **None of the sites hired any extra people to deploy IPv6**
- **Only for infrastructure, not applications**



Resources

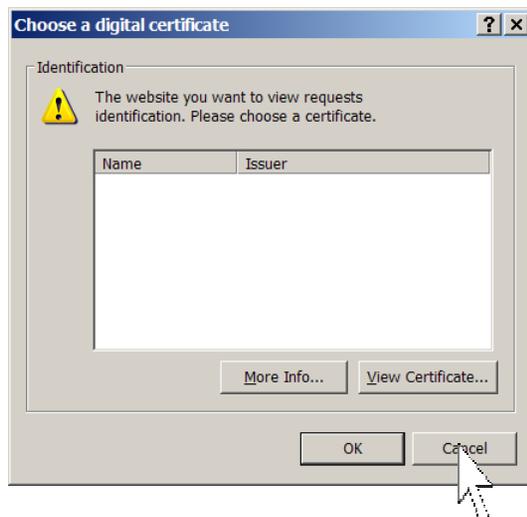
- **Lessons Learned**
 - DREN IPv6 knowledge base <https://kb.v6.dren.net>
 - ARIN IPv6 wiki www.getipv6.info
 - Linux IPv6 HOWTO www.bieringer.de/linux/IPv6/
- **Need an external IPv6-only address?**
 - ipv6.google.com
- **Need to test your IPv6 infrastructure?**
 - www.test-ipv6.com allows you to verify connectivity
 - www.ipv6tools.org allows you to ping, trace, and query DNS
 - ipv6-speedtest.net allows you to test performance ('-' not '.')
- **Want IPv6 connectivity today?**
 - Use the gogoCLIENT from gogoware.gogo6.com and the authenticated.freenet6.net Freenet6 tunnel broker
 - Hurricane Electric provides another: tunnelbroker.net



DREN IPv6 knowledge base access



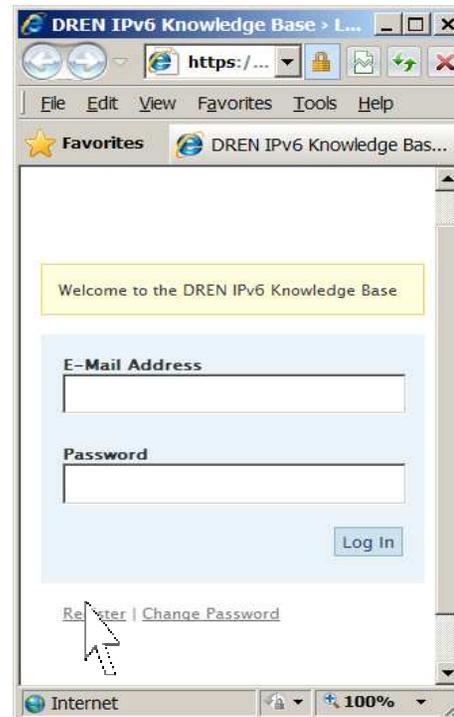
Step 1: In a web browser, go to <https://kb.v6.dren.net>. This window will pop up. Click on Cancel.



Note 1: If you have a DoD-issued Common Access Card (CAC), click on one of the certificates listed. Then click on OK to access the web site. You do not need to complete the registration process.

Note 2: If you use Safari on a Mac and have a DoD-issued CAC, open the "Keychain Access" application, select the CAC keychain, right click on the ID certificate, and then select "New Identify Preference". Enter **both** <https://kb.v6.dren.net> and <https://kb.v6.dren.net/> **before** performing step 1. You do not need to complete the registration process.

Step 2: Another window will open. Do not enter any information. Just click on Register.



Step 3: Another window will open. Enter information shown and click on Submit. Then wait ... a Password will arrive via email.

Access: Repeat step 1. In step 2, enter your E-Mail Address and your Password. Then click on [Log In](#). The temporary Password is changed during initial access.